PATENT ABSTRACTS OF JAPAN

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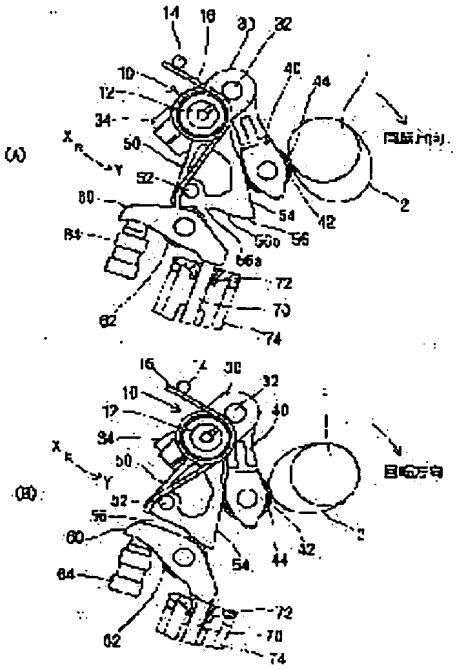
(54) VALVE CONTROL DEVICE

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a valve control device with high degree of freedom of design for controlling a valve timing and an amount of lift with a simple constitution.
SOLUTION: A control arm 30 is turned with a control shaft 12 by a motor. One end of a follower 40 is pivotably supported to the control arm at an eccentric position different from the control shaft 12. A pivot cam 50 is pivotably mounted to the control shaft 12. A rocker arm 60 bonded to a shaft 70 of an intake valve is butted to a pivot cam surface 56 of the pivot cam 50 by an arm roller 62. When a valve cam 2 is rotated at one round and the pivot cam 50 is pivoted at one reciprocation with the follower 40, the intake valve is opening/closing-driven. When a rotation position of the control arm 30 is changed by the motor, a distance between a part where a second roller 44 and the pivot cam 50 are butted and the control shaft 12 is varied. At the same rotation angle position of the cam shaft 1, a circumferential position of the valve cam 2 butted to a first roller 42 is varied.



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* NOTICES *

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CLAIMS

[Claim(s)]
[Claim 1] In the valve-control equipment which receives driving force from a cam shaft and controls the closing motion timing and the amount of lifts of an internal combustion engine's inlet valve or an exhaust valve A control axis, the control-section material which rotates with said control axis, and the rotation driving means which rotates said control axis and changes the rotation location of said control-section material, The transfer member which is attached in said control-section material free [rocking] in a different eccentric location from said control axis, contacts the valve cam prepared in said cam shaft, and is rocked centering on said eccentric location by rotation of said valve cam, It is attached in said control axis free [rocking], and said transfer member is contacted in the location and the opposite side where said valve cam contacts said transfer member. It has the rocking cam which has the rocking cam side which rocks said control axis as a core with rocking of said transfer member, is formed in the predetermined angle-of-rotation range, and carries out the closing motion drive of said inlet valve or said exhaust valve. If said control axis is rotated by said rotation driving means and the rotation location of said control-section material is changed Valve-control equipment characterized by for the hoop direction location of said valve cam which contacts said transfer member in the angle-of-rotation location where said cam shaft is the same changing, and the distance of the part where said rocking cam and said transfer member contact, and said control axis changing.
[Claim 2] When it is valve-control equipment which controls the closing-motion timing and the amount of lifts of an inlet valve and said rotation driving means rotates said control-section material in the direction in which the distance of the part where said rocking cam and said transfer member contact, and said control axis becomes long, the hoop direction location of said valve cam which contacts said transfer member in the angle-of-rotation location where said cam shaft is the same is valve-control equipment according to claim 1 characterized by to move to a tooth-lead-angle side.
[Claim 3] When said rotation driving means rotates said control-section material in the direction in which the distance of the part where said rocking cam and said transfer member contact, and said control axis becomes long, the timing which the timing which opens said inlet valve does not change, but closes said inlet valve is valve-control equipment according to claim 2 characterized by moving to a tooth-lead-angle side.
[Claim 4] The contact side of said rocking cam which contacts said transfer member is valve-control equipment according to claim 1, 2, or 3 characterized by being a flat surface.
[Claim 5] For said rocking cam side, the rate of increase of the rate to which it is formed in the maximum lift location side rather than induction with the small rate of increase of the rate which carries out the lift of said inlet valve or said exhaust valve towards the maximum lift location from the valve-opening starting position of said inlet valve or said exhaust valve, and said induction, and the lift of said inlet valve or said exhaust valve is carried out is valve-control equipment of four given in any 1 term from claim 1 characterized by having the large increment section rather than said induction.
[Claim 6] Said transfer member is valve-control equipment of five given in any 1 term from claim 1 characterized by having the 1st roller which contacts said valve cam, and the 2nd roller which contacts said rocking cam.
[Claim 7] Said 1st roller and said 2nd roller are valve-control equipment according to claim 6 characterized by being installed on the same axle.
[Claim 8] Valve-control equipment of seven given in any 1 term from claim 1 characterized by having the controller material which can adjust the rotation location which attaches said control-section material in said control axis.

[Claim 9] It is valve-control equipment of eight given in any 1 term from claim 1 characterized by said rocking cam side having the cam profile which starts valve opening of said inlet valve or said exhaust valve by the lag side rather than the angle-of-rotation location of said cam shaft in case the acceleration which said rocking cam rocks becomes max.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the valve-control equipment which controls the closing motion timing ("closing motion timing" is hereafter called valve timing) and the amount of lifts of an internal combustion engine's (an "internal combustion engine" is hereafter called engine) inlet valve, or an exhaust valve according to operational status.
[0002]
[Description of the Prior Art] Conventionally, the cam from which a cam profile differs in shaft orientations is prepared in a cam shaft as valve-control equipment which controls the valve timing and the amount of lifts of an engine inlet valve or an exhaust valve according to engine operational status, and what changes the cam profile which drives an inlet valve or an exhaust valve is known by carrying out both-way migration of the cam shaft at shaft orientations.
[0003] However, with the valve-control equipment which changes the cam profile which moves a cam shaft to shaft orientations and drives an inlet valve or an exhaust valve, even if the amount of lifts decreases, a valve-opening period becomes short, or the amount of lifts increases and a valve-opening period becomes long, the maximum lift location does not change. That is, the maximum lift location cannot be changed with change of the amount of lifts. Therefore, the design degree of freedom which controls the valve timing and the amount of lifts of an inlet valve or an exhaust valve is low.
[0004] For example, if in the case of the valve-control equipment for inlet valves the amount of lifts is made small and a valve-opening period becomes short, since the maximum lift location will not change, valve-opening timing will move to a lag side. Since the piston in an engine cylinder will descend before an inlet valve opens if the valve-opening timing of an inlet valve moves to a lag side, the inside of a cylinder becomes negative pressure. Then, a pumping loss occurs and fuel consumption falls.
[0005] In addition to the cam of a cam shaft being formed in shaft orientations in the shape of a taper, and cam profiles differing in shaft orientations, in the valve timing control unit indicated by JP,6-117207,A, it has the rotation phase adjustable means which carries out adjustable [of the rotation phase of a cam shaft]. Thereby, it does not tend to be concerned with change of the amount of lifts of an inlet valve or an exhaust valve, but is going to control the maximum lift location independently.
[0006]
[Problem(s) to be Solved by the Invention] However, in the valve timing control unit indicated by JP,6-117207,A, both the driving means which carries out the both-way drive of the cam shaft at shaft orientations, and the driving means of a rotation phase adjustable means are need, and a configuration becomes complicated. Furthermore, when driving a cam shaft by both driving means, it is difficult to control the amount of lifts and phase of a transient of an inlet valve or an exhaust valve with high precision.
[0007] The purpose of this invention is to offer valve-control equipment with the high design degree of freedom which controls valve timing and the amount of lifts by the easy configuration. Other purposes of this invention control the valve timing and the amount of lifts of an inlet valve, and are to offer the valve-control equipment which improves fuel consumption.
[0008]
[Means for Solving the Problem] According to the valve-control equipment of this invention according to claim 1, a control axis is rotated by the rotation driving means, and if the rotation location of control-section material is changed, the hoop direction location of the valve cam which contacts a transfer member in the angle-of-rotation location where a cam shaft is the same will change. That is, if a rotation driving means rotates control-section material and changes the rotation location of control-section material, when a rocking

cam will receive the driving force of a valve cam from a transfer member and will carry out the closing motion drive of an inlet valve or the exhaust valve, the maximum lift location of an inlet valve or an exhaust valve changes.

[0009] Furthermore, if a control axis is rotated by the rotation driving means and the rotation location of control-section material is changed, the distance of the part and control axis which a rocking cam and a transfer member contact will change. The rocking include-angle width of face of a transfer member is the same even if the rotation location of control-section material changes. However, if the distance of the part where the rocking include-angle width of face of a transfer member is the same and where, as for the rocking include-angle width of face of a rocking cam, a rocking cam and a transfer member contact but, and a control axis changes, it will change. The rocking include-angle width of face of a rocking cam will become small if it will become large if the distance of the part and control axis which a rocking cam and a transfer member contact becomes short, and distance becomes long. If the amount of lifts of an inlet valve or an exhaust valve will become large if the rocking include-angle width of face of a rocking cam becomes large, and the rocking include-angle width of face of a rocking cam becomes small, the amount of lifts of an inlet valve or an exhaust valve will become small.

[0010] While the maximum lift location of an inlet valve or an exhaust valve changes by rotating a control axis by one rotation driving means, and changing the rotation location of control-section material, the amount of lifts of an inlet valve or an exhaust valve fluctuates. Valve-control equipment with the high design degree of freedom which controls valve timing and the amount of lifts by the easy configuration is realizable.

[0011] If a rotation driving means rotates control-section material in the direction in which the distance of the part and control axis which a rocking cam and a transfer member contact becomes long according to the valve-control equipment for the inlet valves of this invention according to claim 2, while the amount of lifts of an inlet valve will become small, the hoop direction location of the valve cam which contacts a transfer member in the angle-of-rotation location where a cam shaft is the same is moved to a tooth-lead-angle side. That is, if the amount of lifts of an inlet valve becomes small and a valve-opening period becomes short, the valve-opening period of an inlet valve will move to a tooth-lead-angle side. Since an inlet valve is changed into a valve-opening condition and can be set when valve-opening timing is moved to a tooth-lead-angle side and the piston in a cylinder descends even if the amount of lifts becomes small, a pumping loss is reduced and fuel consumption can be improved.

[0012] If a rotation driving means rotates control-section material in the direction in which the distance of the part and control axis which a rocking cam and a transfer member contact becomes long according to the valve-control equipment for the inlet valves of this invention according to claim 3, the timing which opens an inlet valve will not change but the timing which closes an inlet valve will move it to a tooth-lead-angle side. That is, even if the amount of lifts of an inlet valve becomes small and a valve-opening period becomes short, the valve-opening timing of an inlet valve does not change. Since an inlet valve is changed into a valve-opening condition and can be set when the piston in a cylinder descends, a pumping loss is reduced and fuel consumption can be improved.

[0013] According to the valve-control equipment of this invention according to claim 4, since the contact side of the rocking cam which contacts a transfer member is a flat surface, manufacture of a rocking cam is easy for it. According to the valve-control equipment of claim 5 ** of this invention, the rocking cam side has induction with the small rate of increase of the rate which carries out the lift of an inlet valve or the exhaust valve towards the maximum lift location from the valve-opening starting position of an inlet valve or an exhaust valve, and the increment section with the larger rate of increase of the rate to which it is formed in the maximum lift location side rather than induction, and the lift of an inlet valve or the exhaust valve is carried out than induction. A rocking cam carries out the closing motion drive of an inlet valve or the exhaust valve with rocking of 1 round trip. Therefore, a rocking cam opens an inlet valve or an exhaust valve toward the increment section from induction, and closes an inlet valve or an exhaust valve toward induction from the increment section. The passing speed of the inlet valve when driving by induction or an exhaust valve is slow, and the passing speed of the inlet valve when driving in the increment section or an exhaust valve is quick. Since a taking-a-seat sound in case an inlet valve or an exhaust valve closes the valve becomes small, a switching noise can be reduced.

[0014] According to the valve-control equipment of claim 6 ** of this invention, the transfer member has the 1st roller which contacts a valve cam, and the 2nd roller which contacts a rocking cam. Since friction in case the driving force of a valve cam transmits to a rocking cam from a transfer member becomes small, the fuel consumption of the engine which drives a valve cam improves.

[0015] Since the 1st roller and the 2nd roller are installed on the same axle according to the valve-control equipment of claim 7 ** of this invention, a configuration becomes easy and a manufacturing cost decreases. According to the valve-control equipment of claim 8 ** of this invention, the rotation location which attaches control-section material in a control axis can be adjusted by controller material. Since it can reduce that valve timing or the amount of lifts varies for every gas column according to a manufacture error, an error with a group, etc., combustion of each gas column is stabilized and fuel consumption improves.
[0016] When a valve cam makes one revolution and a rocking cam is restored once, the acceleration of a rocking cam becomes max between the maximum lift location and a clausilium location between a valve-opening location and the maximum lift locations, respectively. According to the valve-control equipment of claim 9 ** of this invention, the rocking cam side has the cam profile which starts valve opening of an inlet valve or an exhaust valve by the lag side rather than the angle-of-rotation location of a valve cam where the acceleration which a rocking cam rocks becomes max. That is, an inlet valve or an exhaust valve is closed by the tooth-lead-angle side rather than the angle-of-rotation location of a cam shaft where the acceleration which a rocking cam rocks becomes max. Since an inlet valve or an exhaust valve closes the valve before the acceleration which a rocking cam rocks becomes max even if the amount of lifts becomes small and a valve-opening period becomes short, a taking-a-seat sound in case an inlet valve or an exhaust valve closes the valve can be reduced.
[0017]
[Embodiment of the Invention] One example which shows the gestalt of operation of this invention is explained based on drawing. The valve-control system for inlet valves using the valve-control equipment of this invention is shown in drawing 2 . An engine control system (ECU) 100 inputs accelerator opening, water temperature, and the sensor signal that detects engine operation in addition to this, and sends out a control signal to an ignition, a fuel injection equipment, and other control units. The drive current is supplied to the motor 20 of the valve-control equipment 10 shown in drawing 2 from the control circuit 102.
[0018] The valve timing adjusting devices 110 and 112 which adjust valve timing independently are installed in the cam shaft 1 for inlet valves, and the cam shaft 5 for exhaust valves in valve-control equipment 10, respectively. The valve timing adjusting devices 110 and 112 transmit the driving force of a crankshaft to cam shafts 1 and 5, and adjust the rotation phase of the cam shafts 1 and 5 to a crankshaft. A control axis 12 has the rotation angular position controlled by the motor 20 as a rotation driving means.
[0019] As shown in drawing 1 , the control arm 30 as control-section material is being fixed to the control axis 12 with the bolt 34 as controller material. By loosening a bolt 34, the attachment rotation location of the control arm 30 to a control axis 12 can be adjusted. The follower 40 as a transfer member is supported for one edge by the control arm 30 in a different eccentric location 32 from a control axis 12, enabling free rocking. The 1st roller 42 and the 2nd roller 44 are attached free [rotation] on the same axle at the other-end section of a follower 40. The 1st roller 42 is in contact with the valve cam 2 installed in the cam shaft 1. The 2nd roller 44 is in contact with the location where the 1st roller 42 and the valve cam 2 have contacted on both sides of a follower 40, and the rocking cam 50 mentioned later in the opposite side. When the 1st roller 42 rotates in contact with the valve cam 2 and the 2nd roller 44 rotates in contact with the rocking cam 50, friction with a follower 40, the valve cam 2, and a follower 40 and the rocking cam 50 becomes small.
[0020] The rocking cam 50 is attached in the control axis 12 free [rocking]. The spring 16 as an energization means is stopped by the stop member 14 which installed the end in the cylinder head etc., and is stopped by the stop section 52 which is installing the other end in the rocking cam 50. The rocking cam 50 is energized by the energization force of a spring 16 towards the 2nd roller 44. The contact side 54 of the rocking cam 50 which contacts the 2nd roller 44 is a flat surface.
[0021] The rocker arm 60 is in contact with the rocking cam side 56 of the rocking cam 50 with the arm roller 62. The rocker arm 60 is attached in the support shaft 64 for the end, enabling free rotation. The other end of a rocker arm 60 is combined with the shaft 70 of an inlet valve. The shaft 70 is combined with the sheet member 72, and the spring 74 is energizing the sheet member 72 in the direction which an inlet valve closes. When a rocker arm 60 rotates centering on the support shaft 64, the closing motion drive of the inlet valve is carried out.
[0022] Next, actuation of valve-control equipment 10 is explained. If the valve cam 2 makes one revolution, 1 **** of followers 40 will be rocked in X of drawing 1 , and the direction of Y. If the valve cam 2 makes one revolution, 1 **** of the rocking cams 50 will be rocked with a follower 40. If the valve cam 2 arrives at the angle-of-rotation location shown in (A) of drawing 1 , the rocking cam 50 will start rocking, and if the angle-of-rotation location which the valve cam 2 shows to (B) of drawing 1 is arrived at, the rocking cam 50 will arrive at the maximum rocking location.

[0023] The rocking cam side 56 has induction 56a in the side to which an inlet valve starts valve opening, and has increment section 56b in the maximum lift location side rather than induction 56a. As shown in drawing 4 , the increment section 56b of the rate of increase of the rate to which the rocking cam 50 carries out the lift of the inlet valve towards the maximum lift location from a valve-opening starting position is larger than induction 56a. Therefore, while the inlet valve started the lift and the arm roller 62 of a rocker arm 60 is in contact with induction 56a, the lift rate of an inlet valve rises gently. If the arm roller 62 contacts increment section 56b through induction 56a, the lift rate of an inlet valve will rise rapidly.
[0024] Since the arm roller 62 contacts the rocking cam side 56 in order of increment section 56b and induction 56a when the rocking cam 50 reaches to the maximum lift location and returns towards a valve-opening starting position, an inlet valve will return conversely the lift property shown in drawing 4 . That is, a taking-a-seat rate in case an inlet valve closes the valve becomes loose. Therefore, the taking-a-seat sound of an inlet valve becomes small.
[0025] It has the amount of lifts of the valve cam 2, i.e., the rocking location of the rocking cam 50, the acceleration which the rocking cam 50 rocks by rotation of the valve cam 2, and the property indicated to be the amount of lifts of an inlet valve to drawing 5 . The location where the rocking cam 50 starts rocking is a tooth-lead-angle side from the location where an inlet valve starts valve opening. Setting, after starting rocking until it arrives at the maximum lift location, i.e., the maximum rocking location, and by the time it returns from the maximum rocking location to a rocking starting position, the rocking acceleration of the rocking cam 50 has become max. The cam profile of the rocking cam side 56 is set up so that an inlet valve may close the valve by the tooth-lead-angle side rather than the location where the rocking acceleration of the rocking cam 50 becomes max until it will return from the maximum rocking location to a rocking starting position, if it puts in another way as starting the lift of an inlet valve by the lag side rather than the location where the rocking acceleration of the rocking cam 50 becomes max after starting rocking until it arrives at the maximum rocking location. Even if it changes the rotation location of the control arm 30 by the motor 20 and makes the amount of lifts of an inlet valve small so that it may mention later, it is set up so that an inlet valve may close the valve by the tooth-lead-angle side rather than the location where the rocking acceleration of the rocking cam 50 becomes max. Since an inlet valve closes the valve before the rocking acceleration of the rocking cam 50 becomes max, the taking-a-seat sound of an inlet valve can be reduced.
[0026] Next, a motor 20 is rotated and the location shown in drawing 3 is made to rotate the control arm 30. The distance of the part and control axis 12 which the 2nd roller 44 and the rocking cam 50 contact becomes longer than the location shown in drawing 1 . Moreover, the valve cam 2 moves the hoop direction location which contacts the 1st roller 42 to a tooth-lead-angle side rather than drawing 1 in the same angle-of-rotation location of a cam shaft 1. That is, the rocking cam 50 starts rocking rather than drawing 1 in a tooth-lead-angle location.
[0027] The rocking include-angle width of face of a follower 40 is the same even if the location where the 1st roller 42 contacts the valve cam 2 moves to a tooth-lead-angle [of the valve cam 2], or lag side. However, if the distance of the part and control axis 12 which the 2nd roller 44 and the rocking cam 50 contact becomes long, the rocking include-angle width of face of the rocking cam 50 will become small to the rocking include-angle width of face of the same follower 40. On the contrary, if the distance of the part and control axis 12 which the 2nd roller 44 and the rocking cam 50 contact becomes short, the rocking include-angle width of face of the rocking cam 50 will become large to the rocking include-angle width of face of the same follower 40.
[0028] If the distance of the part and control axis 12 which the 2nd roller 44 and the rocking cam 50 contact becomes long and the rocking include-angle width of face of the rocking cam 50 becomes small as shown in drawing 3 , the amount of lifts of an inlet valve will become small. If the amount of lifts becomes small, a valve-opening period will become short. Since the 1st roller 42 contacts the valve cam 2 by the tooth-lead-angle side as mentioned above, the tooth lead angle of the maximum lift location of an inlet valve is carried out. In this example, if the amount of lifts of an inlet valve becomes small and a valve-opening period becomes short, the tooth lead angle of the maximum lift location will be carried out. At this time, as shown in drawing 6 , the location where an inlet valve starts valve opening is made into the almost same timing, and clausilium timing is moved to the tooth-lead-angle side. Since an inlet valve is changed into a valve-opening condition and can be set when the piston in a cylinder descends, it prevents that the inside of a cylinder becomes negative pressure, and a pumping loss can be reduced. Therefore, fuel consumption improves.
[0029] In this example, when the amount of lifts was made small, the valve-control equipment for inlet

valves was set up so that the maximum lift location might carry out a tooth lead angle, but if the amount of lifts is made small, it is also possible to set up the valve-control equipment for inlet valves so that the maximum lift location may carry out a lag. For example, in drawing 1 , if the relative hand of cut of a cam shaft 1 becomes opposite to a follower 40, and the amount of lifts becomes small, the maximum lift location will be moved to a lag side. the case where the amount of lifts is made small also when the configuration of this invention is applied to the valve-control equipment which controls the valve timing and the amount of lifts of an exhaust valve -- the maximum lift location -- a tooth lead angle -- or valve-control equipment can be easily set up so that a lag may be carried out. The valve-control equipment with a high design degree of freedom with which the driving means which controls valve timing and the amount of lifts controls valve timing and the amount of lifts by easy configuration called only a motor 20 is realizable.

[0030] Although the motor was used as a rotation driving means rotating around a control axis 12, the wire link of an accelerator and the control axis 12 may be carried out, and the rotation location of a control axis 12 may be controlled by this example according to accelerator opening. Although valve-control equipment 10 and the valve timing adjusting device 100 which adjusts the valve timing of an inlet valve independently were used for the valve-control system, the valve timing and the amount of lifts of an inlet valve may be controlled by this example only with valve-control equipment 10.

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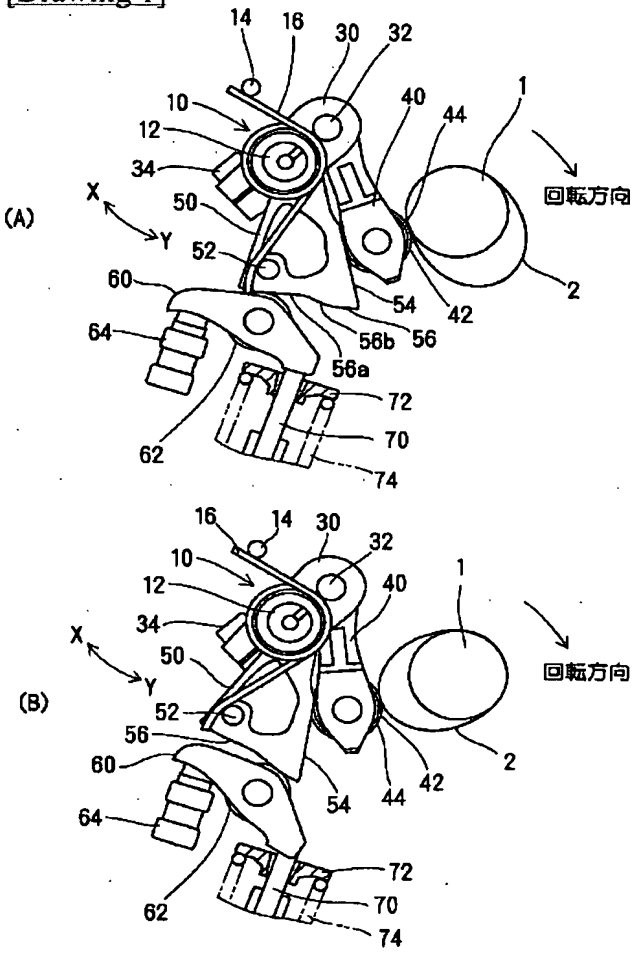
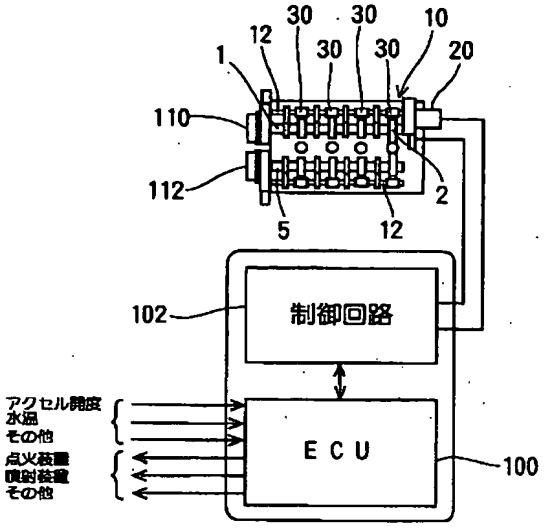
DRAWINGS

[Drawing 1]



[Drawing 2]



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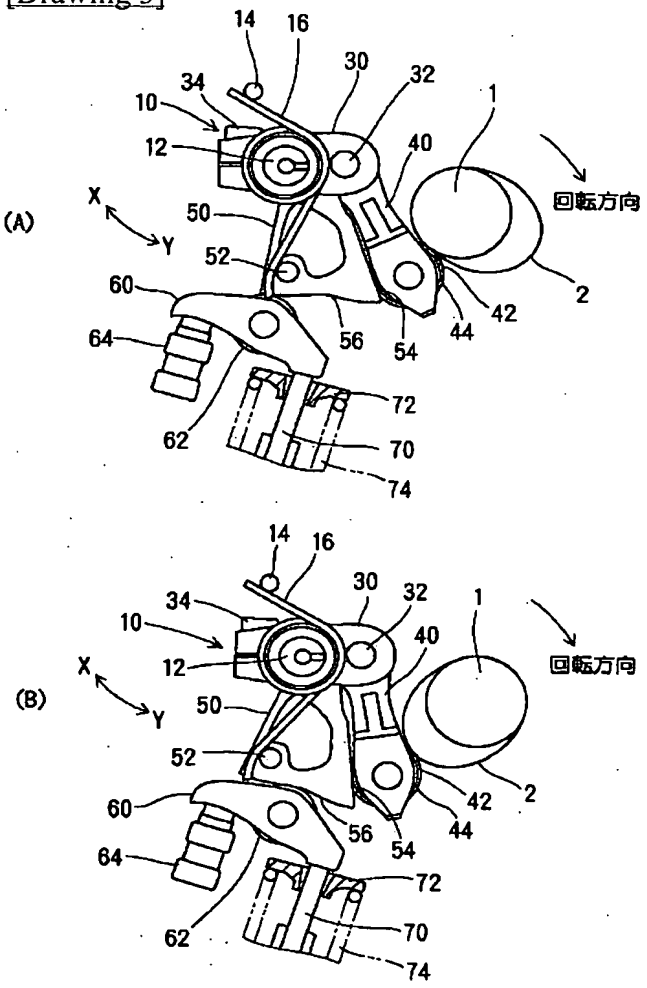

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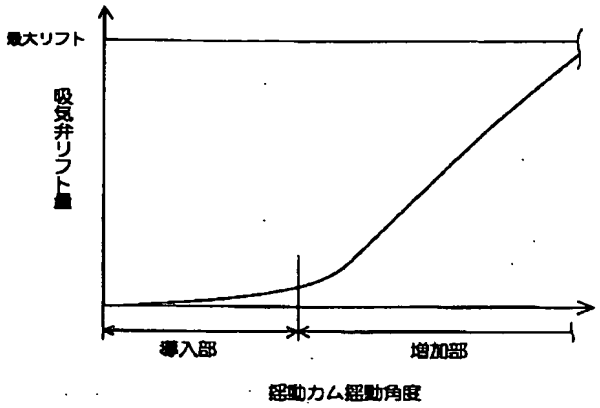

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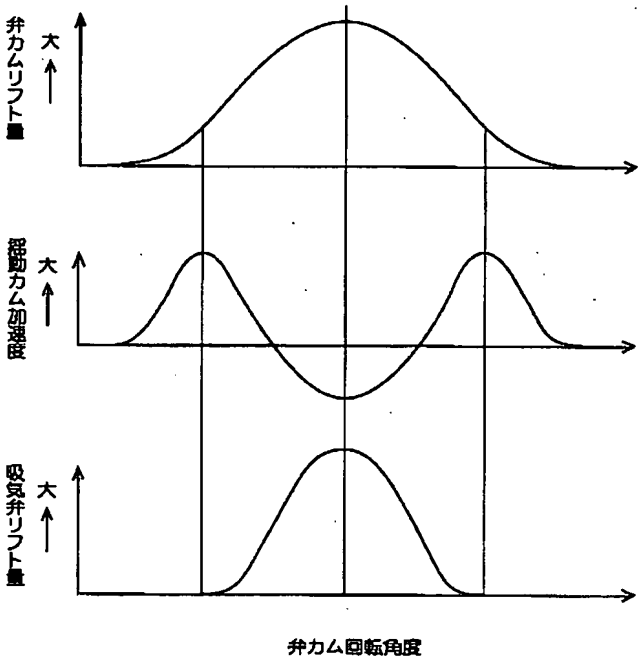
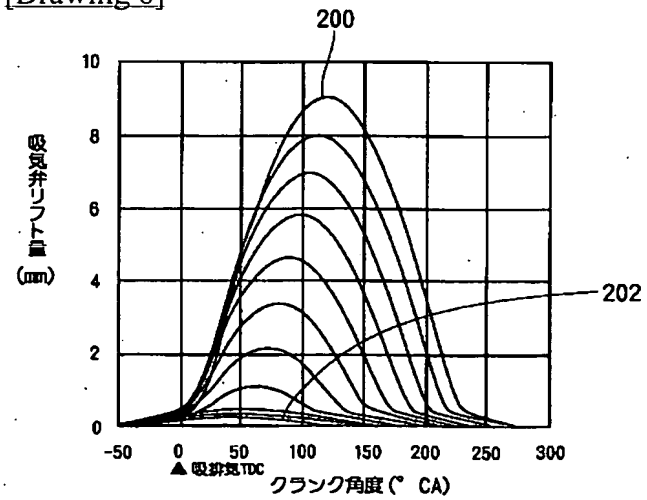


[Drawing 6]



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